Pricing Policy, Structure and Schedule for US Resources and Accommodations on the International Space Station*

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Abstract. Pursuant to congressional action, NASA has established a pricing policy framework incorporating resource bundles priced through value-based pricing with a marginal cost floor. NASA has made provision for waiving the marginal cost floor requirement in the short run in order to stimulate private investment during the formative period of business development. The future of commercial development on the ISS will depend upon demand for ISS utilization at prices corresponding to a market value that exceeds marginal cost.

Introduction

Acting as a steward of America s investment in the International Space Station (ISS), NASA should establish procedures and processes that will maximize the total return to the United States (total social return). Given that the United States will invest substantial sums in the construction of the ISS, it is clearly NASA s responsibility as steward of this investment to secure the maximum achievable return. Unfortunately, the phrases total return to the United States, and maximum achievable return are difficult to define due to the complex nature of the benefits produced by the ISS.

NASA has enumerated ISS benefits that include financial, cultural, and foreign policy value as well as fundamental scientific progress. These benefits range from inspiration and hope experienced by individual school children to precise molecular structures used to design drugs worth many millions of dollars. Much of this benefit is virtually impossible to quantify, making any solution to the problem of maximizing benefit problematic at best. Indeed, the ISS is such a radical leap forward in human experience that we are

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** Opinions expressed herein are those of the author and do not necessarily represent the policy of the National Aeronautics and Space Administration.

unlikely to discover the best approaches for optimizing its total return until we after we have developed an experience base.

As NASA seeks to exploit the ISS for national benefit, the agency will employ several different approaches in parallel. Some ISS benefits are best delivered through a system emulating a free market, while others are more efficiently delivered by applying other competitive processes. For example, NASA will manage the ISS to produce fundamental scientific knowledge and the knowledge that is prerequisite for human exploration through competitive peer-reviewed processes. NASA s methods for producing goods such as these are premised on the widely accepted understanding that free markets are inefficient with respect to basic research. Simply put -- because no entity other than the nation as a whole can hope to capture even a substantial fraction of the benefits from basic research for itself, no entity smaller than the nation as a whole can be expected to shoulder the costs. However, NASA expects that a substantial fraction of the value derived from the ISS will be in the form of goods and services that *are* efficiently produced and distributed through a free and competitive market. NASA has therefore reserved an initial allocation of 30% of ISS resources and accommodations for the use of commercial enterprises. NASA will revisit this allocation on a regular basis and is prepared to expand resources devoted to commercial users if demand (and consequently prices) warrant such an adjustment.

The Space Station Commercial Development Demonstration Program

On 7 October 1999 the US Congress approved the key aspects of a legislative proposal, conceived by NASA and approved by the White House, to establish a Space Station Commercial Development Demonstration Program.[1] This program is to establish a demonstration regarding the commercial feasibility and economic viability of private sector business operations involving the ISS, and The goal will be furthered by the early use of the International Space Station by United States commercial entities committing private capital to commercial enterprises on the International Space Station. [2] The legislation directs NASA to establish and publish a price policy and authorizes NASA to retain any receipts collected in excess of costs for reinvestment. The accompanying conference report notes that NASA may negotiate for payments, at a value set by the private market, and retain any funds received in excess of costs for reinvestment in the station economic development program. [3] The report also instructs NASA to refrain from picking winners and losers in this coming era and instead enable the power of the

[1] United States Congress, Public Law 106-74, 20 October,1999
[2] Ibid.
[3] United States House of Representatives, Conference Report 106-379 [To Accompany HR 2684], 13 October, 1999.

U.S. capital markets to come to bear on this new frontier of U.S. economic development. [4]

As a direct result of this new legislative authority it is incumbent upon NASA to publish, within a reasonable time, a specific price structure and schedule for the US share of ISS resources and accommodations. At the same time, NASA must establish the procedures necessary to ensure that the Space Station Commercial Demonstration Program successfully tests and demonstrates the feasibility and economic viability of private sector business operations involving the International Space Station. [5]

Consistent with legislative direction and with Office of Management and Budget Circular A-25, NASA has adopted a pricing policy framework that incorporates resource bundles priced through value-based pricing with a marginal cost floor. NASA has made provision for waiving the marginal cost floor requirement in the short run, in order to stimulate private investment during the formative period of business development. Any waivers must apply to the primary uses of the ISS, which include research and education. However, the future of commercial development on the ISS will depend upon demand for ISS utilization at prices corresponding to a market value that exceeds marginal cost.

The Pricing Framework

Value- Based Pricing

A market based price for ISS has as its upper bound the value of ISS accommodations as perceived by customers (the highest price they would be willing to pay). The lower bound to a market price is NASA s marginal cost (the lowest price that NASA would be willing to accept under normal market conditions). In a competitive market the market price is expected to approach marginal cost, but since the ISS accommodations are in fixed supply, the market price could vary substantially from marginal cost depending on the shape of the demand curve. The value-based price structure is driven by the perceived value of access to ISS; that is the market-based price is driven by the marginal value that potential customers expect to extract from their activities on the Space Station.

This perceived value is the value-based price referred to in NASA s framework. Perceived value is based upon the expected returns (revenues minus costs, including the cost of capital) from participation discounted by the substantial risks associated with such a novel endeavor. Potential customers are expected to include both the cost of capital and a risk premium in their own assessments of value.

[4] Ibid.
[5] United State Congress, Public Law 106-74, 20 October, 1999

As noted above, a firm s assessment of the value of ISS accommodations represents an upper bound for the price of those accommodations. Firms should be willing to pay a price that approaches the anticipated value of ISS utilization because any price less than the anticipated value represents a net gain for the firm. Since those firms anticipating the highest returns from using the ISS will be in a position to offer the highest prices, the value-based price approach incorporates market incentives for allocating ISS resources to *the highest value users*. Allocating space to the highest value users maximizes value and total social return.

To the maximum extent feasible, NASA seeks to avoid picking winners based on its own business evaluations of proposals. The value based pricing model allows NASA to substitute the discipline of the market for NASA management judgement on the ultimate market value of a given proposal. This is particularly important given the fixed nature of ISS resources. By relying on price as the discriminating factor to the maximum possible extent, NASA uses the broader knowledge and expertise of the market as a whole to allocate resources to high value users and avoids the need to pick winners and losers.

Some proposals to use the ISS may reasonably be expected to create value beyond return to the proposing firm (external value). If, for example, NASA sees value to the American public in supporting a dedicated NASA channel available on cable TV, then surely there is some similar value in such broadcasts produced by third parties. For firms negotiating prices above NASA s marginal cost, these external or public values should be largely irrelevant to the allocation decision. The demonstration program must focus on the feasibility and viability of private sector commercial activity. Transactions characterized by large public benefits relative to the benefits capture by investors are not generally well enabled by private sector market mechanisms.

To the extent that value-based prices exceed NASA s marginal cost, funds will become available for upgrading and improving ISS performance. This flow of funds holds the potential for generating a virtuous cycle of improving value as the upgraded facility creates more value and commands higher prices as a result.

Standard microeconomic theory establishes marginal cost as the appropriate price for maximizing social return (given that a series of simplifying assumptions are met). It might therefore be argued that any pricing scheme that seeks to set prices above marginal cost is likely to result in sub-optimal total benefit. (This results when customers that value ISS utilization above marginal cost but below the higher price are left without access.) Note however that ISS resources are fixed in supply and NASA is in a position to negotiate individual prices. As long as the ISS resources are fully subscribed, there is no dead weight loss; that is there are no resources, which go unused due to high prices.

By creating a surplus for NASA s benefit, the policy makes funds available for investment in the ISS while providing an incentive for NASA to attract the highest value

users. Customers face incentives to focus on high value uses since access is governed by ability to pay. Further, this arrangement provides a strong incentive for NASA management to focus on high value customers.

Perceived values are notoriously difficult to elucidate in the absence of vigorous competition. Each customer has a strong incentive to misrepresent the value placed on a given transaction in order to minimize prices. This set of incentives combined with a pure value based pricing structure could lead to prices that settle permanently below marginal cost. Such prices would represent a continued subsidization of commercial activity in space beyond the substantial sums already invested in fixed and sunk costs. Clearly, this is undesirable and inefficient. Therefore, NASA will institute a marginal cost floor for value based prices.

The Marginal Cost Floor

Marginal cost pricing is theoretically the optimal pricing policy if our objective is to maximize total social return in the short term. The rationale for pricing at marginal cost is straightforward: every customer for which total benefits exceed total costs can afford to secure access, so net benefit is maximized. Prices below marginal costs may attract customers who derive less benefit from using the ISS than the costs that NASA shoulders on their behalf. While the customer would still be better off under these circumstances, such an arrangement clearly represents a net loss for the country as a whole (not to mention an unfair transfer of wealth from taxpayers to ISS users).

Technically, marginal costs of a particular commercial project include only those costs that NASA would incur directly because of the decision to fly that commercial project. Stated another way, these are the costs that NASA would not incur if a given commercial project were not flown. This definition eliminates fixed and sunk costs from consideration and includes only those costs that are affected by the decision to fly a given commercial project. By restricting consideration to costs that would actually be effected by a particular commercial project, we ensure the most efficient allocation of resources.

As a practical matter it can be very difficult to identify true marginal costs when the cost structure of a firm is rigid (as is NASA s cost structure). For example, it is unlikely that NASA will fire or hire workers based on the decision to fly or not to fly a given commercial project. It is also unlikely that the decision to launch or not to launch a Space Shuttle will be contingent on a particular commercial project. In the short term, almost all of NASA s costs are fixed, and variable costs to NASA tend to be very small with respect to any specific commercial project.

In order to arrive at a useful and meaningful measure of marginal cost, NASA will employ a time frame that includes an entire fiscal year of operation. NASA will estimate a marginal cost based on the decision to implement the Space Station Commercial

Development Demonstration Program for a given fiscal year. This involves the reasonable assumption that operating costs are variable costs at the beginning of any fiscal year. NASA could choose to cancel the demonstration program and invest the operating costs of the program in something else.

This marginal cost for the program in total for one year will then be distributed across commercial projects based upon the fraction of project resources that a given commercial project consumes. Essentially, we estimate marginal cost based upon average variable cost within a given fiscal year.

NASA will establish a price for a standard bundle of resources associated with each site including the site itself, power, crew-hours, and space-to-ground data transmission. Bundling resources will reduce transactions cost during the initial phases of the program.

Space Shuttle cargo transportation is excluded from the bundles and priced separately so as to avoid any creation of a government competitive advantage over privately offered space transportation services in the future.

To provide additional flexibility, NASA has established premium prices for specific accommodations and resources, which can be ordered outside of the standard bundle. These prices are not meant to reflect marginal cost; instead, they are based on comparable resource prices from prior transactions.

NASA will release a full definition ISS resource bundles and costs in February.

Waivers

There may arise situations in which the best price NASA can negotiate for a project falls below the marginal cost to NASA as defined above. Such projects may be worthwhile if they are expected to generate benefits to the United States, which are not captured by the proposing firm and which may therefore generate a net positive return to NASA s investment when all beneficiaries are considered. The NASA administrator may grant waivers of all or part of marginal cost on such projects on a case by case basis when the total benefits (including benefits to the public or third parties) exceed the marginal cost to NASA.

It may be necessary to grant waivers to firms that expect to generate revenue in the future but require an initial period of support to reduce uncertainty and risk. In the long run, business ventures must be prepared to cover the marginal cost floor, and waiver applications should include projections of costs and revenues consistent with this requirement.

In addition, the definition of marginal cost established above is necessarily crude and imperfect. There may arise circumstances under which the actual marginal cost for a given project is below the estimate called for in the definition above. In these circumstances, the NASA administrator may grant a waiver in order to secure the available social return.

Cost waivers may be granted for primary uses of the ISS such as scientific and technological R&D and education. Non-primary uses such as entertainment and advertising, if pursued, will not be granted waivers.

Procedures and Policies

NASA has outlined its process for processing proposals to the Commercial Development Demonstration Program in an ISO-9000 compliant Office Work Instruction.[6] Such proposals are designated Entrepreneurial Offers, i.e. written offers for a new or innovative idea, involving ISS assets, that [are] submitted to NASA on the initiative of the offeror for the purpose of creating value-added products or services for sale in private markets

Beginning in February 2000 NASA will accept proposals from U.S. firms and organizations for participation in the Commercial Development Demonstration Program. Proposals will be ranked based on criteria as described below. NASA will maintain a prioritized ranking of projects and manifest them for flight in priority order through the ISS manifesting process as resources become available to the demonstration program.

Proposal Content

As part of ongoing efforts to evaluate the Commercial Development Demonstration Program, NASA will require substantially more information in each proposal than a simple bid price.

Each proposals must contain a detailed description of activities planned and results expected as well as a proposed schedule for development and execution. In addition, NASA will require a business plan which forecasts production, revenues, costs, profit and loss and cash flow, *in accord with standard business practice*.

Proposals to Waive Marginal Cost

Proposals for participation in the Commercial Development Demonstration Program that offer prices below marginal cost will be expected to include the same information as non

[6] Bush, L. Registration and Disposition Process for Space Station Entrepreneurial Offers, STAIF-2000, 2 February, 2000.

waiver proposals as well as additional material. Waiver proposals will need to justify waiver status consistent with the explanation of waiver proposals described above. In addition, waiver proposals must, through the required business plan, identify at what future point government subsidies are expected to fall away.

Waiver proposals will be expected to demonstrate benefits to the United States, which are not captured by the proposing firm and which may therefore generate a net positive return to NASA s investment when all beneficiaries are considered.

*Criteria for evaluating proposal*s

As described in the framework section above, NASA s preferred method for prioritizing access to space is by price, with the highest priced proposals having highest priority. Thus, the agency would exhaust all proposals above marginal cost before allocating access to proposals at marginal cost and finally selecting from among proposals requesting a waiver of marginal cost requirements only higher value proposals are addressed. In this manner the ratio of private to public investment becomes the determinative factor and capital markets ultimately make the allocation decision.

NASA will consider other criteria in the evaluation and prioritization process. The presence of non-government markets will be an important factor. The completeness and credibility of the proposal, the availability of financing, will naturally need to be evaluated. In addition, NASA will review the proposals for relevance to the core mission of the space station and potential for demonstrating the commercial feasibility and economic viability of private sector business operations involving the ISS.

Criteria related to safety will always remain paramount.

Policy on resale of ISS commercial resources

NASA anticipates that some customers may wish to resell resources acquired as part of their original proposals. If not closely managed, such transactions could impose unacceptably high transactions costs on NASA and other ISS customers due to the complex nature of ISS operations and planning. At least for the initial demonstration period, NASA will require that all resale arrangements be fully described within the original proposal to the program. NASA will closely evaluate proposals containing resale provisions to ensure that such provisions impose no excess burden on NASA management infrastructure or on other ISS customers.

Conclusion

The Commercial Development Demonstration Program is one element of a broader NASA initiative to reap the maximum benefits for Americans from their investment in the ISS. The novelty of the entire ISS experiment, and the diverse approaches to extracting value from the ISS require that NASA remain flexible in its approach. Results from the early years of ISS activities will strongly influence the future balance and direction of the program. The demonstration program will help NASA to identify and understand the best uses of the ISS and results from the program will provide the basis for future allocations of ISS accommodations and resources among commercial and non commercial endeavors.

We anticipate demand for Space Station resources at prices above marginal cost will be low in the early years due to uncertainty about the value of ISS resources and the absence of an existing market for these resources. Early customers may seek to extract value primarily in the form of entertainment, experience, or advertising, as these are likely to be investments with the quickest return. As the ISS matures, we would expect stronger demand from commercially supported research and development programs. ISS research, coupled with a dramatic reduction in the cost of access to space could lay the foundation for the full commercial exploitation of human presence in space in a foreseeable future.

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